BIBLIOGRAPHICAL NOTICES.

XII. *A Critical and Experimental Essay on the Circulation of the Blood, especially as observed in the minute and capillary vessels of the Batrachia and of Fishes.* By MARSHALL HALL, M. D., F. R. S. E., M. R. I., M. Z. S., &c. &c. London. 8vo. 1832.

Dr. Marshall Hall, the author of the work of which we propose to offer a brief analysis in the present article, must be allowed to be a zealous and laborious investigator, and an indefatigable writer. Although scarcely past the meridian of life, he has contributed more amply to the medical literature of his country than almost any of his contemporaries; and while it is freely confessed that we cannot discover in his various productions, the indication of a transcendant genius, no one will refuse to concede that they afford evidences of sound judgment, industrious research, and not a few original and useful views, which entitle the author to our respect, and justify the satisfaction which the reading portion of the medical profession in England, and we may add in this country, experience on the appearance of a new work from his prolific pen.

The subject treated of in the present essay is one of great interest to physiologists, for there are few topics on which more has been written, which are viewed in a more diversified manner, and on which, consequently, positive decisions are more desirable than the circulation of the blood in the capillaries, the powers which circulate the blood, and the influence of the brain and spinal marrow upon the circulatory function. On all these points the remarks and experiments of Dr. Hall, as detailed in the present work, are calculated, we think, to throw some light, and to enable us to arrive at more satisfactory conclusions than we have heretofore been able to do.

In a short introductory chapter, Dr. Hall indulges in some sensible remarks on the principles of investigation in physiology. According to him, the sources of our knowledge in that department of medical science, or, indeed, in all natural science, are observation and experiment. The former consists in a sustained and watchful attention to events which pass under our eye in the ordinary course of nature; the latter, in devices for placing natural objects in new and unusual circumstances or situations. The following principles are laid down by him for the prosecution of physiological investigations. 1*st*. Never to have recourse to experiments, in cases in which observation can afford us the information required. 2*d*. Never to perform an experiment without the persuasion, after the most mature consideration, that the object desired will be attained by that experiment, in the form of a real and uncomplicated result. 3*d*. Never to repeat experiments which have been performed by physiologists of reputation, unless there be some doubt respecting their accuracy, or the accuracy of the deductions drawn from them. To these he adds, *4th*, that when a given experiment has been concluded to be essential and adequate to the discovery of a truth, it should be instituted with the least possible infliction of suffering; and

5th, that every physiological experiment should be performed under such circumstances as will secure a due observation and attestation of its results, and so obviate, as much as possible, the necessity for its repetition.

"The whole science of medicine and surgery is dependent on physiology. To exclude physiological investigation, would be to erect an utter barrier to the progress of our art, viewed in any other light than as mere empiricism. They alone can repair a machine who understand its construction and its movements.

"In thus stating the argument in regard to what is right and just in physiological investigation, I have steered a course equally distinct from the heartless cruelties practiced by some soi-disant physiologists, and the senseless declamations of others against what they are pleased to call vivisections. The whole argument may be concentrated to a point:—are Harvey, Haller, and Hale, worthy of our applause for their researches into the circulation and the action of the heart? Let us remember that they performed experiments. It is not, therefore to experiments that we can object, but to such experiments as are unnecessary or useless, or performed without regard to the pain or sufferings inflicted. We may at the same time admire the conduct of one experimentalist and condemn that of another."

The first chapter of the work is occupied with an inquiry into the anatomy of the minute and capillary vessels. Dr. H. sets off with the remark, that all the descriptions of these vessels and of the circulation in them, contain so many inaccurate statements, that they appear to have been written from the imagination rather than from actual observation. He cites as examples of such inaccuracies what is alleged of the frequent anastomoses and conjunctions of the minute arteries, and of the immediate termination of these arteries in veins, as they are observed in the web of the frog;—anatomical dispositions, which if they occur at all, do so so very rarely, that after the most diligent search, he could never be able to detect them in a single instance. Influenced by the conviction that the real course and distribution of the vessels in question and the real phenomena of the minute, arterial, capillary, and venous circulation are very peculiar and highly interesting, Dr. H. has devoted much time to a patient investigation of these subjects, and has presented in the chapter before us the results of his observations. His experiments appear to have been conducted with great care, and with a due regard to all the circumstances that could insure perfect accuracy. He employed the achromatic microscope of Mr. Dollond, and devised peculiar modes of placing the moving scenes he had to examine under the field of its object-glass. Dr. Hall very properly remarks, that in describing the minute and capillary vessels and circulation, we should attach distinct ideas to the various terms employed, and especially distinguish the capillary vessels from the minute arteries from which they arise, and from the minute veins to which they give origin; because a neglect of these circumstances has given rise to the confusion which pervades the descriptions extant on that subject. His views relative to the arrangement of those vessels will be gathered from the following extract:—

"The minute vessels may be considered as arterial, as long as they continue to divide and subdivide into smaller and smaller branches. The minute veins are those vessels which gradually enlarge from the successive addition of smaller roots. The true capillary vessels are obviously distinct from each of these. They do not become smaller by subdivision, nor larger by conjunction, but they are characterized by continual and successive union and division, or anastomoses, whilst they retain a nearly uniform diameter." "These distinctions are highly important. Without them, the phenomena cannot be clearly described or understood. It is quite erroneous to speak of capillary arteries or capillary veins, or of the true capillary vessels as a venous net-work,—as vessels containing a serous blood without globules, or as rather to be inferred than accurately seen. The last branches of the arterial system and the first root of the venous, may be denominated minute; but the term capillary must be reserved and appropriated to designate vessels of a distinct character and order, and of an intermediate station, carrying red globules, and perfectly visible by means of the microscope. Meckel is obviously in error, in omitting to mention the capillaries altogether; and Adelon, in speaking of the capillary system in the plural number, including under that designation the nutrient, secretory, and exhalant vessels."

We may here mention, that Dr. Hall's mode of proceeding, which enabled him to place under the microscope the lung and mesentery of animals, in order to ascertain whether there be any difference between the systemic and pulmonary minute and capillary vessels and circulation, and insured a continuance of the circulation, unimpeded and undisturbed, for a sufficient time, is founded on an observation originally made by Mr. Edwards, and mentioned in that distinguished physiologist's work on the influence of physical agents, viz. that batrachian reptiles, placed in water of 42° of the centigrade thermometer, or 108° of Fahrenheit die almost immediately. On repeating these experiments, with the view to ascertain the cause of so sudden an annihilation of life in these animals, Dr. H. found, that although sensation and motion had entirely ceased, and the animal had become rigid and apparently dead, the action of the heart still continued. Having placed the lung of the animal under the object-glass of the microscope, he was gratified to find the circulation, arterial, capillary, and venous, quite perfect, and "had thus an opportunity of contemplating at leisure, in one instance during four successive hours, under circumstances free from the infliction of pain or suffering, this most splendid and interesting scene." Dr. Hall subsequently found that water of the temperature of 120° Fahr. answers far better than water at 108°.

With a view to determine the point to which we have alluded above, whether there be any difference between the capillary vessels of the systemic circulation and those of the pulmonic, Dr. Hall examined, in the way mentioned, the fin and tail of the stickleback, the web of the frog's foot, the mesentery of the toad, and the lungs of the salamander, frog and toad. The account he gives of the physical characters and arrangement of the minute and capillary vessels of both the systemic and pulmonic circulations is the most distinct and intelligible we are acquainted with, and has led Dr. H. to the conclusions respecting the character of these vessels, which we have already stated in his own words. We are aware, that his account applies solely to the capillary system of the saurial and batrachoid reptiles; but it is reasonable to believe, the same arrangement, if it really occurs in them, will be found to prevail in the higher orders of animals. But however interesting the details on the subject may be, we are compelled to omit them in this place and to refer such of our readers as may be curious on matters of that kind, to the volume itself. We can make room only for the following extract.

"If we institute a general comparison between the systemic and pulmonary circulation, we shall arrive at the following conclusions. The arteries in the former divide and subdivide at considerable intervals, until they become extremely minute; and from the rapidity of the circulation, are only distinctly seen by the aid of the higher powers of the microscope; in the latter, the subdivisions of the minute arteries take place at the nearest points along its course, the arteries terminate abruptly, the branches assume at once the capillary characters. The veins are formed in a manner perfectly similar to that of the division of the arteries, in the systemic and pulmonary circulation respectively; the capillary vessels of the systemic circulation are far less numerous and more tortuous than those of the lung. It may be said, that in the web, the vessels are adapted to support the nutrition and life of its various textures; in the lung, that the membrane is a mere scaffolding to spread the vessels which convey the blood in the fullest manner over its extensive surface."

This description applies more particularly to the difference in the arrangement of the vessels in the systemic and pulmonic circulatory apparatuses of the salamander, but will do so with trifling modification, to the differences in the other reptiles examined by Dr. Hall.

The next subject which Dr. H. investigates, consists of the powers which circulate the blood. The question of the entire circulation, he remarks, is a problem made up of so many elements, that it is not extraordinary it should have been so difficult to fix and limit the value and influence of each; and that as usual in the absence of proofs, the subject should have been rendered more obscure by being veiled in a variety of conjectures. According to him the circle performed by the blood may be not inaptly divided into four arcs. Of these the heart must be viewed as the principal and first; the arteries as the second; the capillary vessels as the third; and the veins as the fourth. "To view each arc distinctly, as well as the whole circle connectedly, will greatly assist us in forming accurate views of the nature of the circulation."

In order to present to his readers a sketch of the opinions of the principal physiologists who have chiefly occupied themselves in the investigation of the powers which move the blood, and thus indicate the state of our knowledge on that subject, at the time he commenced his own researches, Dr. Hall favours us with long extracts from the works of Galen, Harvey, Haller, Spallanzani, Tourdes, Bichat, John Hunter, Huxham, &c. After doing this he passes to the detail of his own observations.

"*Of the extent of the influence of the heart in the circulation.*"—Dr. H. remarks that if the circulation in the web of the frog be carefully examined under the most favourable circumstances, it will be found to be very rapid in the arteries, much less so in the capillary vessels and in the veins, and equable in all. He has almost invariably been able to detect, with a good microscope, a degree of pulsatory acceleration of the blood in the arteries at each contraction of the heart, and is disposed to conclude, from his own observations, that the natural circulation was rapid and entirely pulsatory in the minute arteries, and slow but equable in the capillary and venous systems. The pulsatory movement, at each systole of the heart, becomes very manifest whenever the circulation is in the slightest degree impeded. Under such circumstances it is seen in all the three systems of vessels, arterial, capillary and venous. "In the arteries there is generally an alternate more or less rapid flow of the globules, at each systole and diastole of the heart; in the capillaries and veins, the blood is often completely arrested during the diastole, and again propelled by a pulsatory movement, during the systole of that organ." Dr. Hall thinks that these phenomena are conclusive proofs that the power and influence of the heart extend through the arteries to the capillaries, and through these to the veins, even in the extreme parts of the body.

Evidence of the muscular action of the arteries.—In support of the existence of an important influence of the arteries, Dr. Hall adduces the fact of a perfect circulation in acardiac fœtuses and acardiac animals. Nevertheless he admits, that it may be contended, that much in the circulation, in such cases is effected in the capillaries. He further adduces, in support of this important influence in the arteries, the circulatory apparatus in fishes and the crustacea; the former of which have a simple pulmonic heart only, the latter a single aortic heart. To these arguments derived from cases of monstrosity and from comparative anatomy, Dr. H. has added that from experiment. He repeated thrice an experiment originally performed by Haller and Spallanzani, and which consists in excising the heart and marking the results.

> "A ligature was applied round the aorta of a frog. The circulation in the web, which was previously very vigorous, was almost immediately arrested, first in the capillaries, then in the veins. In the arteries there was a singular oscillatory movement of the blood for ten or fifteen minutes. The globules of blood proceeded slowly onward for some seconds; there was then, all at once, a rapid retrograde movement of the blood apparently through the same space. The oscillation was repeated; the globules of blood were again moved alternately in progressive and retrograde directions as before. It appeared to me, that the artery gradually contracted, in successive portions, and slowly emptied itself by propelling the blood in a continued stream along its final branches; that it then dilated suddenly, and drew the globules of blood in a rapid retrograde course.
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> "During the first contraction of the artery, the blood would be propelled along the capillaries and veins. During the succeeding contractions and relaxations of the artery, the globules would merely oscillate, being driven forwards and drawn backwards alternately. From these observations, it would appear almost certain, that the arteries possess a muscular contractile power."

But these are not the only circumstances adduced by Dr. Hall in favour of the contractile power of the arteries. He further points out, as corroborating his opinion; 1st. The anatomical arrangement of these vessels, referring to Mr. Hunter for the details on the subject, and for the arguments flowing from it. 2d. The augmented impulse in particular arteries,—a phenomenon particularly noticed by Laennec. 3d. The effect of elevated temperatures upon these organic tubes. On the latter subject our author remarks, that he had not only observed that the batrachia, on being exposed to water of 120° of Fahrenheit, died almost instantly; but that the superficial muscles became rigidly contracted. He exposed the heart to the influence of water raised to this temperature, and noticed that this organ immediately became small, pale, and rigid. This circumstance led him to presume, that the experiment might confirm or correct our views respecting the muscularity of the arteries and of other textures of the body. Having tried the experiment, he found that a mere fibre of a longitudinal muscle was shortened and made rigid, while a portion of membrane or nerve underwent no change. He next took an artery and vein which lay nearly flaccid upon a portion of glass, and placed them in the water. The artery immediately became rigid and cylindrical, while the vein suffered no apparent change. Dr.

Hall thinks that the results of these experiments furnish an important confirmation of the opinion, that the arteries possess a muscular and consequently a contractile tissue. Yet he frankly admits that none of the above arguments are absolutely decisive. The function of the arteries, he says, are mingled in the cases of the acardiac fœtuses and acardiac animals, in the fish tribe and in the crustacea, with that of the capillaries; and unless we are enabled to separate these two orders of vessels, it is impossible that we should ascertain the function appropriate to each. The argument derived from the structure and the augmented action of the arteries, and the influence of an elevated temperature, he regards as more distinct. "The apparent effect of alternate contraction and relaxation of the artery after the ligature of the aorta, is certainly most powerful; indeed it scarcely admits of a remaining doubt of the structure and function of the arteries."

Nevertheless, Dr. H. thinks it is important that this possible doubt should be removed,—an object which he regards as satisfactorily effected by the interesting fact, discovered by him, of an artery in the frog and toad, which pulsates distinctly for a considerable time after the removal of the heart.

"The artery to which I allude, is a branch from each of the arteries which in the frog and toad, after separating at a short distance from the heart, rejoin and form the aorta. Pursuing its course backwards and downwards, it passes under the transverse process of the third vertebra. It is here bound down. It is also very tortuous. When the viscera are removed, two pulsating points are distinctly seen at this part. On a minute examination, these pulsating points are found to be portions of cellular and muscular textures, above and below the transverse process just mentioned, moved by the contraction of a subjacent artery. On removing these textures carefully, and on removing the skin from the back of the animal, the part along which the artery passes on emerging from beneath the transverse process, is sufficiently thin and transparent to admit of its being placed under the microscope. The artery is then plainly seen to pulsate, becoming straighter and paler at each contraction. The adjacent textures are moved at the same time, and the blood is frequently seen to oscillate in a branch of the same artery situated very near it." "In this fact we have the most, and, I may add, the only indubitable proof of a contractile action in an artery."

Want of proof of irritability in the true capillaries.—Dr. Hall remarks, that the flow of blood through the capillaries appears in every instance to be effected and modified by powers impressed upon it, and of a character extraneous to any action of these vessels themselves. The following circumstances are offered in support of this opinion. 1st. The influence of the contraction of the heart is quite obvious upon the motion of the blood in the capillaries. 2d. The struggles of the animal have an influence in retarding or arresting the flow of blood in these vessels, or rendering it retrograde. 3d. Any cause of contraction in the membranes forming the web itself, has a remarkable influence upon the course of the blood in the veins and capillaries. 4th. If the limb be bound with a tight ligature, the blood is rendered retrograde in its movement along the minute veins and the capillaries, by slight degrees of pressure made upon that part of the limb which intervenes between the ligature and the web. The blood is thus simply pressed out of the large vein of the limb in a retrograde course along its roots and the capillary vessels. 5th. We frequently remark anastomosing branches between the veins of the web of the frog. The globules of blood in them vary in their course at every moment, and in every possible manner. Similar phenomena are noticed in the capillaries themselves; and especially in those occupying spaces between two adjacent veins. Every kind of movement in the globules of blood may be observed in these vessels, the obvious and distinct result of forces impressed upon them, or of issues afforded them. 6th. When the course of the blood along a large vein is arrested, this vessel immediately assumes the character of an artery, apparently giving off branches, instead of receiving roots—the globules of blood pursuing a retrograde course.

Dr. Hall opposes the following objections to some experiments performed by Dr. Philip, (from which that distinguished physiologist argued for a contractile power in the capillaries,) in which, after the brain and spinal marrow had been crushed, an effect was observed upon the circulation in the capillaries similar to what is observed in the heart under similar circumstances; the capillary circulation like the beat of the heart being immediately arrested or impaired. 1st. The influence of the heart itself was not removed. 2d. The influence of the arteries, which Dr. Hall thinks he has proved to possess a contractile power, was not separated from that of the capillaries with regard to which the question remains to be determined. 3d. The capillary circulation was also left subject to the influence of contraction in the whole muscular system.

As regards Dr. Philip's other argument in support of a contractile power in the capillaries, derived from observing the effect of the application of various substances to the web upon the capillary circulation and vessels, Dr. H. remarks, that—1st. The pain inflicted accelerates the circulation. 2d. The struggles of the animal variously retard or arrest it. 3d. The action of the irritant upon the membranes of the web, upon the parietes of the vessels, and upon the contained blood is various and complicated, so that it is impossible to determine whether the action of the capillaries themselves be augmented or diminished, or whether these vessels, admitting them to possess any vital contractile powers, be excited or debilitated, in so complicated an experiment. From all that precedes, it is obvious, according to Dr. H., that whilst every fact relative to the capillary circulation leads us to ascribe its various phenomena to forces impressed upon it from without, there is nothing of satisfactory evidence or argument for an automatic power in them.

We may here mention that, in a postscript to chapter second, contained in the preface, Dr. H. observes, that some further deductions may probably be drawn from the experiment of applying a ligature round the large vessels connected with the heart, beyond that of the irritability of the arteries, and in favour of the absence of contractile power in the capillaries. To this he is led by the observation of the fact, that under such circumstances a peculiar, slow, oscillatory movement of the blood is observed in the arteries, whilst that of the capillaries and veins is motionless; a circumstance which could not hold if these vessels had the same power of irritability as the arteries.

Dr. Marshall Hall treats, in a separate section, "of the influence of the acts of inspiration and expiration, upon the venous circulation." In regard to the influence of the former of these acts, he contents himself with quoting a passage from the work of Dr. Barry, whose views he seems to adopt, and with endeavouring to refute some of the objections raised against them by Dr. Philip.

In reference to the influence of expiration, he remarks, that when the circulation is seen proceeding rapidly in the web of a frog, (though previously arrested during some minutes,) it is often arrested, *de novo*, on pressing or even touching the animal—an effect arising probably from fear, and ceasing when the frog has been some time in its new situation. This cessation of the circulation, Dr. H. thinks, depends upon interrupted breathing with the action of the expiratory muscles, and is easily produced at any time by making a moderate pressure upon the thorax.

> "In this manner, we observe the effect of the effort of expiration, actual expiration being prevented by the closure of the larynx. It seems to be the reverse of the experiment of Dr. Barry. Its influence extends to the extreme parts of the circulating system. The influence of inspiration, in Dr. Barry's experiment may do so too: but I confess I think it remains to be determined, where the influence of inspiration and of the atmospheric pressure begins; or in other words, how far it extends from the thorax itself."

The author next enumerates various modifications in the flow of the blood along the minute and capillary vessels. He remarks, that under the influence of certain modifying causes, as pressure, the struggles of the animal, a ligature round the limb or large vessels, excision of the heart, the flow of blood along the minute arteries and veins and capillary vessels, becomes variously pulsatory, oscillatory, retrograde, or arrested, in one or other of these three series of vessels.

As we cannot make sufficient room for the author's details on these subjects, some of which have already been adverted to by us, we must refer for them to the work itself, and terminate the analysis of Dr. Hall's second chapter with the following quotations from a "postscript" contained in the preface.

> "The due diffusion of the blood in the minute and capillary vessels, appears to be regulated by a principle of tension subsisting between the contents of these vessels, their parietes, and the integuments. It is on this principle that the blood leaves the vessels of the web as the powers of life decline. It is on this principle that the blood flows into other channels when its proper channel is obstructed. It is on this principle that the blood flows in all directions to the point at which a vessel is wounded or opened, as in the experiments of Haller and Spallanzani. It is on this principle, that there is an apparent circulation in the minute vessels after the excision of the heart, or the division of the large vessels of a limb. This movement of the blood is towards the point of division, and therefore retrograde in the arteries. The effects of increased tension in the integuments are readily seen on extending the web more or less tightly; a feeble circulation is perfectly arrested, and the more powerful circulation is greatly modified by this means." "This tension of the integuments is, I think, the source of many of the phenomena of the minute and capillary circulation."

The next subject to which Dr. H. directs the attention of his readers is, the influence of the brain and spinal marrow upon the circulation. Previous to stating his own experiments and observations on that point, he gives, by means of long quotations, an account of those of Spallanzani, Fontana, Whytt, Legallois, Philip, Clift, Flourens, all of whom have investigated, with various results, this interesting physiological question. We shall not follow our author in these details, because to do so would necessitate more room than we can conveniently spare, and because the writings of most of the physiologists we have enumerated are of easy access. Nor shall we enlarge much on the facts and experiments upon which Dr. Hall has founded his opinion on the subject before us, as it will be sufficient for our present purposes to offer a summary of his conclusions. Before doing this, however, we must be allowed to state briefly our author's views respecting the criteria of the power of the action of the heart, and the nature of the action of the heart after its removal from the body.

Legallois judged of the power of the heart by the fulness of its carotids and by the hæmorrhage observed on amputating a limb. Similar modes of judgment were adopted by Dr. Philip, who, however, added to them the observation of the circulation in the web of the frog. Dr. H. is not satisfied with these modes, and thinks it is essential to observe the results of the experiments with greater minuteness. This may be done by attending to the changes which take place in the circulation of different parts. For example, the circulation first ceases—

> "In the extreme, and then in the proximate parts of the web; first in the capillaries and veins, and then in the arteries. It may still be seen in the lungs, however, in which it ceases in the same order, in the distant parts and capillary vessels first, then in the larger arteries; at length the lung ceases to be moved by the power of the contraction of the heart. Even at this period, the apparent action of the heart itself is vigorous and regular, and continues so for a very considerable time. Criteria of the power of the heart are thus afforded us, in the continuance of the circulation, first in the web, and next in the lung, and lastly in that of the beat of the heart itself."

Dr. Hall refuses to admit, that the action of the heart, after the removal of the brain and spinal marrow, or where that organ is taken out of the body entirely, differs in any manner except in feebleness, from its natural beat; an opinion held by Legallois, who referred the movements of the heart, under such circumstances, to the exercise of its irritability, and assimilated them to those elicited in other muscles, during some time after death, by irritation.

> "That this observation," Dr. H. says, "is unfounded, appears from the following facts. If instead of removing the heart alone, it be removed together with the other viscera, in the salamander or the toad previously rendered insensible, its beat is not only still observed to continue, but the circulation is distinctly seen in the pulmonary, minute and capillary vessels. A slight degree of this circulation is still seen, if a double ligature be carefully passed under the heart, and then separated and tied above and below this organ and the roots of the lungs. In this case every part is removed except the heart and pulmonary vessels; so that it approaches as nearly as possible to the case of the removal of the heart alone. Yet the action of this organ is still such as to carry on in a slight degree, and for a short period, the circulation of blood through the pulmonary artery and a few of the capillary vessels. It may also be observed, that in the last experiment, scarcely any part of the nervous system remained; its masses were entirely removed, its filaments alone were left to influence the result of the experiment."

After detailing a number of experiments instituted for the purpose of ascertaining the effect of removing the whole of the brain and spinal marrow at once, Dr. Hall allows that they all appear to prove that the action of the heart is enfeebled from the moment it is deprived, suddenly, of the combined influence of the brain and spinal marrow. The connexion of this organ, with the nervous system, seems, according to him, to be precisely of the same nature as that of the voluntary muscles. Both possess a degree of irritability independently of the large masses of the nervous system; both if separated from these masses, gradually lose this irritability. The irritability, he adds, is doubtless a faculty or property of the muscular fibre; yet it may become extinct without any obvious change in that fibre. Its continuance or renewal depends ultimately upon the masses of the nervous system.

> "The experiments which have been detailed, seem to prove, that from the moment of the abstraction of the brain and spinal marrow, the irritability of the heart begins to fail. The circulation is first enfeebled, then lost, in the most distant parts of the system, then in parts less and less remote. The distance to which it extends may be aptly taken as expressive of the remaining power of the heart, the principal organ of the circulation."
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> "These experiments appear on the other hand to disprove the opinion of Legallois, repeated by M. Flourens, that the power of each part depends upon that portion of the spinal marrow which is adjacent to it, and from which it receives its nerves."

Dr. Hall shows, by means of experiments, the error of Flourens, who maintains that the spinal marrow exercises an influence over the circulation merely in so far as it influences the respiratory process; and that the first of these functions is arrested by the destruction of the medulla oblongata. In Dr. Hall's experiments the destruction of this part did not produce the effect in question any more than the destruction of any other portion of the cord. He consequently concludes that the circulation no more depends upon the medulla oblongata than upon the medulla spinalis.

Legallois was of opinion that the circulation of a part was arrested by the removal of that portion of the spinal marrow from which it derives its nerves. M. Flourens at first adopted the same view of the subject; though he afterwards appears to have modified it from the results of more recent experiments in which the spinal marrow in frogs and in some kinds of fish was destroyed, while the circulation in the lower parts of those animals—the very parts supplied by this portion of the cord, continued. Dr. Hall's experiments have, as we have seen, afforded the same results. These experiments also confirm an observation made by Legallois, that by destroying small portions of the medulla spinalis at a time, and at intervals, a much larger extent of that cord can be removed without arresting the circulation than if the destruction of the whole had been effected suddenly. Dr. H. accounts for this circumstance in the following manner.

> "If a portion of the masses (nervous) be removed, and if this be compatible with life, the animal is reduced to a lower degree in the scale of organized beings. It lives as a still lower animal; and it becomes capable, on this principle, of enduring new privations. I doubt not that, in this manner, the whole brain and spinal marrow may be removed, and that the animal may live, sustained by the mere ganglionic masses, and the cutaneous respiration."

He adds that from the moment, in the experiments performed for ascertaining the above point, the whole of the brain and medulla was destroyed, the circulation gradually, progressively, but slowly failed. From this Dr. Hall once more concludes, that it cannot by any means, be said that the circulation is independent of the brain and spinal marrow. It is proper to observe, however, that in a chapter on the influence of other organs upon the heart and circulation, he explains more explicitly than he had heretofore done his views in relation to the nature of the connexion between the nervous centres and the heart.

"Whatever may be the character of that connexion which subsists between the brain and spinal marrow, and the heart and the circulation, the same thing is observed in regard to other organs or parts, and the organs of circulation. There may be a difference in degree, but there is none in kind. The heart may be more independent of a limb than of the spinal marrow; it may be less influenced by crushing the former than the latter, but still the principle is the same. It is one of mutual connexion rather than of individual function."

He attributes the transmission of these effects to the medium of the organic structures, and says that if the heart and circulation be viewed as independent of the brain and spinal marrow, yet impressible through them, this is equally true of their relation to the stomach or a limb. He admits that it is impossible to remove the brain and spinal cord at once without impressing the powers of the circulation, so that the motion of the blood in the capillary vessels immediately fails in the extreme parts of the system, and gradually in those placed nearer the heart; but adds, that crushing the limbs, &c. annihilates the circulation, and yet this function is, strictly speaking, independent of any of the limbs.

Dr. Hall states that he has been greatly disappointed in repeating the experiment of applying stimulants to the brain and spinal marrow in the batrachia. The results which he obtained differ very materially from those recorded by Dr. Philip. The latter, as many of our readers may perhaps recollect, found that alcohol, when applied to the muscular fibre, impaired its sensibility; that when applied to the brain or spinal marrow, it increased the action of the heart, and that solutions of opium or tobacco increased that action, though in a less degree, an effect followed by a considerable diminution of energy. In the experiments which our author instituted in order to settle this point, he found that alcohol and laudanum enfeebled the circulation of the web, that a watery solution of opium obliterated the circulation, and brought on complete tetanus, similar to that produced by strychnia, and that alcohol applied to the surface of the brain and spinal marrow, previously rendered insensible by laudanum, produced no acceleration whatever either in the beat of the heart or in the motion of the blood in the web.

Dr. Hall remarks, that he has always distrusted the experiments in which irritant or stimulating substances have been applied to the web of the frog, in order to determine the question of the irritability of the capillary vessels; because this kind of experiment involves too many causes of complication, to admit of any conclusion being drawn from them respecting either the nature or function of the vessels in health, or their modifications in disease. Much of the effects obtained he refers to pain and fear, both of which influence powerfully the circulation of the capillaries, and are even sufficient when acting together, to arrest it temporarily. To these sources of confusion must be added the struggles of the animal, which are occasioned by the pain, and cause the blood to stop, to oscillate, and to become irregular in its motion. The next effect produced by such experiments is, according to the nature of the substance applied, various degrees of constriction or corrugation of the external membranes of the web itself, which will induce various impeded or even retrograde movements in the globules of the blood. The application of a stimulant will also variously affect the textures of the subjacent minute and capillary vessels, and induce proportionate changes in the motion of the globules of blood; and it is almost certain, that the influence of some substances extends even to the contents of the minute and capillary vessels.

Dr. Hall presents in a separate chapter, "a brief account of the singular phenomenon of a caudal heart in the eel," and in another chapter some interesting remarks on the effects of warm water on muscular textures. But for the details on both these subjects we must refer to the volume itself.

In taking leave of the work before us, we must be permitted to express, once more, a favourable opinion of its merits. While doing this, however, we are not prepared to join Dr. Hall in all the conclusions he has deduced from his experiments and observations. But as we could not expatiate on all those points on which he appears to us to have erred or decided too hastily, without extending this article far beyond its intended limits, we have abstained entirely from obtruding our own remarks, and leave our readers to make their inferences from the views presented by Dr. Hall.

R. La R.

XIII. *Geschichtliche Darstellung des ausbruchs der Asiatischen Cholera in Hamburg. Nach Acten und Amtlich angestellten untersuchungen.* Von J. C. G. Fricke, Dr. Hamburg, 1831. 8vo. pp. 92.

A Historical Account of the Occurrence of the Asiatic Cholera in Hamburgh, &c. By J. C. G. Fricke, M. D.

The first case of cholera occurred in Hamburgh on the 5th of October, 1831. At this period no disease had appeared within a circumference of thirty German miles of the city, presenting any resemblance in its symptoms to the epidemic then prevailing in other parts of the north of Europe. The same increased tendency, however, to gastric and intestinal affections, which had been observed to precede the appearance of the cholera, wherever the latter had heretofore manifested itself, had been noticed for several months by the physicians of Hamburgh—by whom the progress of the epidemic was anxiously watched, and its phenomena, as it approached nearer and nearer to the city, studied with the utmost care.

As early as the month of May, so far as it regards quarantines and other restrictive measures, every precaution appears to have been taken to preserve the city from the visitation of the dreaded pestilence.

The first three cases of the disease occurred within the walls of Hamburgh, in a place called the deep cellar, situated in Nicolai street, about three hundred feet from the harbour. This cellar is described as a damp, filthy, unventilated place, many feet below the surface of the earth, into which the water of the river Elb flows whenever the latter rises above its ordinary level. The several apartments into which this cellar was divided, were occupied by forty-one individuals, of both sexes and of all ages—the whole of whom were of the most depraved and dissipated habits.

The first case was reported to the police board on the evening of the 5th of October, by Dr. Hauptfleisch. It occurred in a drunkard, of the name of Peterson, sixty-seven years of age. He had come home about 6 o'clock on the preceding evening, and after partaking of a considerable quantity of sour milk, drank a number of glasses of ardent spirits. Soon afterwards he was seized